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10/528986

SUCTION DEVICE FOR A POWER TOOL

JC17 Rec'd PCT/PTO 24 MAR 2005

Background Information

The present invention is based in particular on a suction device for a power tool according to the definition of the species in Claim 1.

Suction devices for suctioning away material removed during the machining of work pieces, in particular drill dust and drill cuttings that accumulate when working with a drilling and/or chipping tool, are widespread. The removed material should be suctioned away and captured as close as possible to the site of origin to prevent it from spreading in the surroundings, in particular in living spaces.

A suction device for a drilling and/or chipping tool with a dust container and a suction head to be placed on a work piece that forms the general class is made known in US 005 113 951 A.

Advantages of the Invention

The present invention is based on a suction device for a power tool, in particular for a drilling and/or chipping tool, with at least one dust container and at least one suction head to be placed on a work piece.

It is proposed that the dust container be integrated in the suction head. This allows the removed, suctioned-away material to be captured as soon as it is produced and prevents the removed material from contaminating a large partial section of the suction device, in particular a suction fan.

The dust container is considered to be integrated in the suction head in particular when a suction part of the suction head forms a single unit with the dust

1 container that is noticeably continuous in three dimensions and, particularly
2 advantageously, is rigidly connected therewith. Embodiments of the present
3 invention are feasible, however, in which the dust container is located in a front
4 region of a suction duct that connects the suction part with the suction fan, and a
5 section of the suction duct that is smaller than a total length of the suction duct is
6 located between the suction part and the dust container. Particularly
7 advantageously, a suction device according to the present invention is usable
8 with drilling and/or chipping tools. It is also feasible for it to be used for milling,
9 scraping or other power tools with which removed material is produced in a
10 narrowly constricted area.

11
12 In a further embodiment of the present invention, this suction device includes a
13 suction unit integrated in the power tool for producing a vacuum in the suction
14 head. As a result, as compared to a power tool with a suction device configured
15 as an external assembly, greater operator comfort can be achieved and a trailing
16 connecting tube between the suction unit and the power tool can be avoided.

17
18 In addition, function integration and an economical, handy and lightweight power
19 tool can be advantageously obtained when the suction device includes a cooling
20 fan of the power tool. The cooling fan can then advantageously perform the
21 function of motor cooling and the function of the suction unit to produce a
22 vacuum. Embodiments with a separate cooling and suction air flow, and a
23 continuous air flow that performs both functions, are also feasible. Separate
24 cooling and suction air flows can be achieved using separate fans—which may
25 be located on a common drive shaft—which are provided as separate fan wheels
26 or which can be integrated in one common fan wheel, or by a realization, for
27 example, in which the suction air flow performs a cooling function after it passes
28 the cooling fan.

29

1 If the suction device includes a unit that includes at least the suction head and is
2 detachably retainable on the power tool, the unit can be easily removed to be
3 cleaned or in particularly narrow spaces.

4
5 In a further embodiment of the present invention, it is proposed that a unit that
6 includes the dust container be detachably retained on the power tool. This
7 advantageously allows the dust container to be emptied in a comfortable
8 manner.

9
10 Embodiments of the present invention in which the detachable unit is retainable
11 using a snap-in connection are particularly advantageous, by way of which
12 attachment and release of the unit are enabled in a particularly rapid and
13 comfortable manner. Other attachment methods, in particular tool-free methods,
14 are also feasible, however.

15
16 If the suction head is supported on a housing of the power tool by a bearing unit
17 such that it is displaceable along a working direction, relative motion between the
18 suction head and a work piece can be advantageously prevented or at least
19 controlled in a desired manner, while the power tool moves relative to the work
20 piece in the working direction. With drilling and/or chipping tools in particular, the
21 suction head can be retained in a region of the drilling hole on the surface of the
22 work piece, independently of a current depth of a drilling hole. Embodiments of
23 the present invention in which a spring mechanism returns the suction head to a
24 home position after it has been displaced and then relieved of load are
25 particularly advantageous. If the bearing unit includes a depth stop, a separate
26 device for adjusting a depth stop can be advantageously spared.

27
28 If the suction head includes at least one opening through which a tool is capable
29 of being guided in at least one operating state, removed material can be
30 suctioned away reliably and essentially completely in the direct vicinity of the site
31 of its origin. If, in addition, various dimensions can be selected for the opening,

these dimensions can be matched particularly advantageously to the dimensions of the tool. Continuous selection options for the dimensions of the opening, such as slidable apertures, for example, and discrete selection options, such as replaceable perforated disks, for example, are also feasible.

In a further embodiment of the present invention, it is proposed that the opening form one end of a funnel-shaped receiving area that tapers in the working direction. This provides an operator with an advantageous view of a suction site without decisively impairing the effectiveness of the suction device.

If the suction head also includes a duct section via which an air flow is capable of being introduced into the dust container in the circumferential direction of the dust container, a swirling air flow can be advantageously achieved in the interior of the dust container, and separation of the removed material from the air flow can be supported by the fact that turbulences are prevented, and by a centrifuge effect.

Drawing

Further advantages result from the following drawing description. Exemplary embodiments of the invention are shown in the drawing. The drawing, description, and claims contain numerous features in combination. One skilled in the art will also advantageously consider them individually and combine them to form further reasonable combinations.

Figure 1 shows a suction device and a power tool with a dust container and a suction head,

Figure 2 shows a section of the suction device in Figure 1 with a unit that has been removed and contains the dust container,

Figure 3 shows a further removeable unit of the suction device in Figures 1 and 2 in a side view,

- 1 Figure 4 shows the unit in Figure 3, in a front view,
2 Figure 5 shows a component of the suction device in Figures 1 through 4,
3 and a replaceable cover plate,
4 Figure 6 shows an insert, formed out of rubber, of a suction device in
5 Figures 1 through 5,
6 Figure 7 shows an alternative suction device and a power tool in a side view,
7 Figure 8 shows the suction device and the power tool in Figure 7 in a top
8 view,
9 Figure 9 shows a section of a guide rod of the suction device in Figures 7
10 and 8,
11 Figure 10 shows a section along a line X – X of the guide rod in Figure 9,
12 Figure 11 shows an opened, rotatably supported valve and a section of a
13 suction duct of the suction device in Figures 7 through 10,
14 Figure 12 shows the valve in Figure 11 in a closed configuration,
15 Figure 13 shows a schematic sketch of a suction head with a suction duct—
16 that widens in the shape of a spiral—of the suction device in
17 Figures 7 through 12,
18 Figure 14 shows a section along a line XIV – XIV of the suction head in
19 Figure 13,
20 Figure 15 shows a section along a line XV – XV of the suction head in Figure
21 13 with a filter,
22 Figure 16 shows a depth stop of the suction device in Figures 7 through 15 in
23 a side view,
24 Figure 17 shows the depth stop in Figure 16 in a top view,
25 Figure 18 shows a further alternative suction device with a handle in a view at
26 an angle from the front,
27 Figure 19 shows the suction device in Figure 18 in a view at an angle from
28 the back,
29 Figure 20 shows a suction head of the suction device in Figures 18 and 19 in
30 a view from below,

- 1 Figure 21 shows the suction head in Figure 20 in a sectional view along line
2 XXI – XXI,
3 Figure 22 shows a dust container of the suction head in Figure 20 and Figure
4 21 in a sectional view along a line XXII – XXII,
5 Figure 23 shows a profile of a guide rod and a section of the handle of the
6 suction device in Figures 20 through 23, and
7 Figure 24 shows the guide rod in Figure 23.

8

9 Detailed Description of the Embodiments

10

11 Figures 1 and 2 show a power tool 10a, an impact drill in this case, with a suction
12 device that includes a dust container 12a and a suction head 14a to be placed on
13 a work piece 16a, whereby suction head 14a includes a suction part 34a and
14 dust container 12a, so that the latter is integrated in suction head 14a.

15

16 In power tool 10a, an integrated suction unit 18a can produce a vacuum in
17 suction head 14a during operation. Suction unit 18a uses a drive motor 36a of
18 power tool 10a, on shaft 38a of which an impeller 40a draws in an air flow from
19 suction head 14a via a suction duct 42a through a filter 44a located in dust
20 container 12a and through dust container 12a and, in its function as cooling fan
21 20a, directs it further into a housing 26a of power tool 10a. In suction head 14a
22 during operation, air and removed material that is carried along is suctioned up
23 through openings 30a, 30a' in suction part 34a and, via a duct section 82a of
24 suction duct 42a extending perpendicularly to a working direction 24a, is
25 introduced through a duct section 82a of suction duct 42a into said dust container
26 in a circumferential direction of dust container 12a, so that swirling is produced in
27 dust container 12a. Supported by a centrifugal effect, particles of the removed
28 material can separate from the air flow and become deposited on the bottom
29 (Figure 5). Suction part 34a and dust container 12a are provided with a
30 plexiglass disk 70a on a side facing work piece 16a to enable visual inspection of
31 the amount of removed material that has collected in dust container 12a.

1 Embodiments of the present invention with transparent partial regions located on
2 sides and/or on a top side of the dust container for visual inspection purposes are
3 feasible.

4

5 Two guide rods 46a, 48a that form a bearing unit extend parallel to suction duct
6 42a, the guide rods being retained at a first end on dust container 12a and being
7 supported at a second end—as is a front duct piece of suction duct 42a—in
8 tubular recesses in a retention part 50a of suction duct 42a such that they are
9 displaceable in a telescoping manner along their longitudinal extension (Figure
10 4). Coil compression springs (not shown) in the interior of guide rods 46a, 48a
11 return the suction device to a starting configuration after it is relieved of load. As
12 a result, suction head 14a is also supported on housing 26a of power tool 10a
13 such that it is displaceable along working direction 24a.

14

15 A ring is installed on guide rod 46a that, when rotated, snaps into a toothed
16 profile 54a and can be released therefrom. In the snapped-in state, this ring limits
17 the ability of guide rods 46a, 48a to slide in a direction opposite to working
18 direction 24a, whereby its end face serves as depth stop 28a (Figure 3, Figure
19 4). An embodiment of the present invention that includes a scale for measuring a
20 drilling hole depth on a guide rod is feasible.

21

22 Retention part 50a, front duct piece of suction duct 42a, guide rods 46a, 48a and
23 suction head 14a with dust container 12a and suction part 34a form one unit that
24 can be removed from power tool 10a (Figure 2). It is detachably retained on
25 power tool 10a using a laterally displaceable snap-in connection 66a. Retention
26 part 50a, on its side facing power tool 10a, and power tool 10a, on its side facing
27 retention part 50a, each include guide rails with L-shaped profiles. For mounting,
28 unit 22a is slid against working direction 24a along the guide rails onto power tool
29 10a, whereby it is guided by the guide rails in the directions perpendicular to
30 working direction 24a. In a setpoint position, a wedge 78a of snap-in connection
31 66a that is loaded by a two-leg spring 80a and supported such that it is laterally

1 displaceable snaps into place in a corresponding snap-in element of power tool
2 10a and fixes unit 22a in place. To detach unit 22a, wedge 78a of snap-in
3 connection 66a—which is integrally molded on a slider—can be slid out of its
4 snap-in position.

5
6 In addition, a further unit 72a that includes dust container 12a and suction part
7 34a can be removed from this unit 22a to empty dust container 12a and/or to
8 clean or replace filter 44a. A further snap-in connection 68a including a lever 74a
9 with a hook on one end is used for this purpose; when dust container 12a is in
10 the installed state, the lever holds a cover 52a of dust container 12a tightly
11 against said dust container, the cover being configured as a single component
12 with the front duct part and being joined with filter 44a. When lever 74a of snap-in
13 connection 68a is pivoted, the hook becomes disengaged and unit 72a can be
14 removed (Figure 2).

15
16 Suction part 34a is configured substantially in the shape of a can and includes
17 openings 30a, 30a' in a base plate and a cover plate 88a, through which said
18 openings a tool 32a can be guided during operation. Openings 30a, 30a' each
19 form an end of receiving regions of suction part 34a that taper in the shape of a
20 funnel in working direction 24a, thereby advantageously enabling an operator to
21 look through openings 30a, 30a' to a region of a drilling hole in work piece 16a.
22 The base plate is formed by plexiglass disk 70a, which can be replaced with
23 alternative plexiglass disks (not shown) that have different dimensions with
24 regard for the funnel-shaped receiving region and/or with regard for opening
25 30a', thereby enabling the selection of different dimensions for opening 30a'. In
26 addition to the base plate, cover plate 88a is also designed to be replaceable
27 (Figure 5). Suction part 34a further includes an elastic insert 76a made of rubber
28 with slits extending tangentially to a circumferential direction of an opening 30a'',
29 the insert being insertable, as an option, in place of cover plate 88a and flexibly
30 in a range of drill sizes (Figure 6).

Alternative exemplary embodiments are shown in Figures 7 through 19. In the exemplary embodiments, components that are substantially the same in the description are labelled with the same reference numerals, with letters a – c added to designate the various the exemplary embodiments. Furthermore, the description of the exemplary embodiment in Figures 1 through 6 can be referred to with regard for features and functionalities that are the same. The description below is limited substantially to the differences from the exemplary embodiment in Figures 1 through 6.

Figures 7 and 8 show a power tool 10b with an alternative suction device that includes a flexurally soft suction duct 42b configured as a tube. In addition, the suction device includes a bearing unit configured as a guide rod 46b that includes two elements with U-profiles that match up in a region to form a closed profile. A coil tension spring 56b that produces a retractive force is located in the interior space of the region of the closed profile. On the ends of said U-profiles, the elements—which are oriented in opposing directions—of guide rod 46b with guide elements 84b, 86b are connected with each other such that they are displaceable along a working direction 24b, by way of which guide rod 46b may be slid in a telescoping manner. Guide elements 84b, 86b are fastened to the elements of guide rod 46b with screws 90b, 90b', whereby screws 90b, 90b' are used simultaneously as hangers for pulling hooks of coil tension spring 56b (Figure 9). When the elements of guide rod 46b are telescoped, coil tension spring 56b is extended and produces a retractive force.

Guide rod 46b can be secured to a housing 26b of power tool 10b using a ring above drill chuck 64b at a cylindrical connection point, at which point a handle can also be mounted.

Suction duct 42b can be connected via a valve 58b that is rotatably supported in housing 26b of power tool 10b to a suction unit 18b integrated in power tool 10b to produce a vacuum (Figures 11 and 12).

1 To produce an increased suction effect, suction head 14b includes a suction duct
2 60b that widens in a spiral-shaped manner from an opening 30b outward and
3 empties into a dust container 12b (Figure 13). In the region of opening 30b, a
4 side of suction head 14b facing work piece 16b includes an opening through
5 which an air flow is suctioned, during high-speed operation, between work piece
6 16b, in particular a wall, and suction head 14b, by way of which removed material
7 is suctioned away directly at work piece 16b (Figures 14 and 15).

8
9 Figures 16 and 17 show a depth stop 28b of suction device, the C-shaped body
10 of which grips a first element of guide rod 46b as a clamp around the U-profile
11 and the top side of which the second element of guide rod 46b can impact. On an
12 open side of depth stop 28b, two legs 94b, 94b' of depth stop 28b engage in the
13 U-profile of the element of guide rod 46b and are retained there by a coil
14 compression spring 110b in opposite directions in tilted positions, by way of
15 which depth stop 28b is prevented from sliding without releasing the tilted
16 position of either of legs 94b, 94b'. The tilted position of legs 94b, 94b' can be
17 released by applying pressure 98b to one of the levers 96b, 96b' installed on legs
18 94b, 94b', by way of which, via the application of pressure 98b, depth stop 28b
19 may be displaced in the direction of the application of pressure 98b.

20
21 A further alternative suction device includes a handle 62c installed on a ring for
22 mounting the suction device on a not-shown power tool in a manner that is
23 variable relative to an angle around working direction 24c, on which said ring a
24 bearing unit configured as a guide rod 46c is also mounted (Figures 18 and 19).
25 Furthermore, the ring includes a receptacle (not shown here) for a conventional
26 depth stop configured as a separate rod. A dust container 12c is rotatably
27 supported in a retention region 100c of suction head 14c, by way of which dust
28 container 12c is rotatable around a drilling axis relative to handle 62c when the
29 suction device is in the installed state, and by way of which it is possible to fit the
30 suction device in tight-spaced drilling situations (Figure 20). Furthermore, dust
31 container 12c is detachable from retention region 100c and includes flaps 102c,

1 102c' configured as a single component with a body of dust container 12c that,
2 when dust container 12c is detached from retention region 100c, automatically
3 close dust container 12c (Figure 22). A dust sack 104c is installed in an interior
4 space of dust container 12c and is kept open by a support device 106c.

5
6 Guide rod 46c includes two elements with substantially C-shaped profiles (Figure
7 23) which, together, form an interior space in which a coil tension spring 56c is
8 located. On their ends, guide elements 92c, 92c' are pressed into the elements of
9 guide rod 46c, in which said guide elements coil tension spring 56c engages and
10 on which damping regions acting as spacers are provided that prevent coil
11 tension spring 56c from becoming fully compressed.

12

1

Reference numerals

10	Power tool	60	Suction duct
12	Dust container	62	Handle
14	Suction head	64	Drill chuck
16	Work piece	66	Snap-in connection
18	Device	68	Snap-in connection
20	Cooling fan	70	Plexiglass disk
22	Unit	72	Unit
24	Working direction	74	Lever
26	Housing	76	Insert
28	Depth stop	78	Wedge
30	Opening	80	Two-leg spring
32	Tool	82	Duct section
34	Suction part	84	Guide element
36	Drive motor	86	Drive element
38	Shaft	88	Cover plate
40	Impeller	90	Screw
42	Suction duct	92	Guide element
44	Filter	94	Leg
46	Guide rod	96	Lever
48	Guide rod	98	Pressure
50	Retention part	100	Retention region
52	Cover	102	Flap
54	Toothed profile	104	Dust sack
56	Coil tension spring	106	Support device
58	Valve		

2